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ABSTRACT

This curriculum guide lists science topics and concepts, learning outcomes, and sample learning objectives (in three columns) for these secondary school science courses in Alaska: (1) general science (grades 7-12); (2) life science (grades 7-12); (3) physical science (grades 7-12); (4) earth science (grades 8-10); (5) biology (grades 10-12); (6) chemistry (grades 10-12); (7) geology (grades 10-12); and (8) physics (grades 10-12). Topics/concepts, in the first column, describe the major parts of the subject under consideration. They define broadly the content to be included in the study of each subject area. Learning outcomes, in the second column, describe, in general terms, the behaviors students are expected to demonstrate as a result of their learning experiences. These outcomes are the goals toward which student learning is directed. Sample learning objectives, shown in the third column, are indicators of student progress toward the stated goals. At least one sample learning objective is stated for each learning outcome. (JN)

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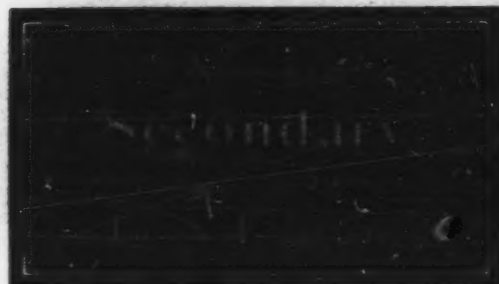
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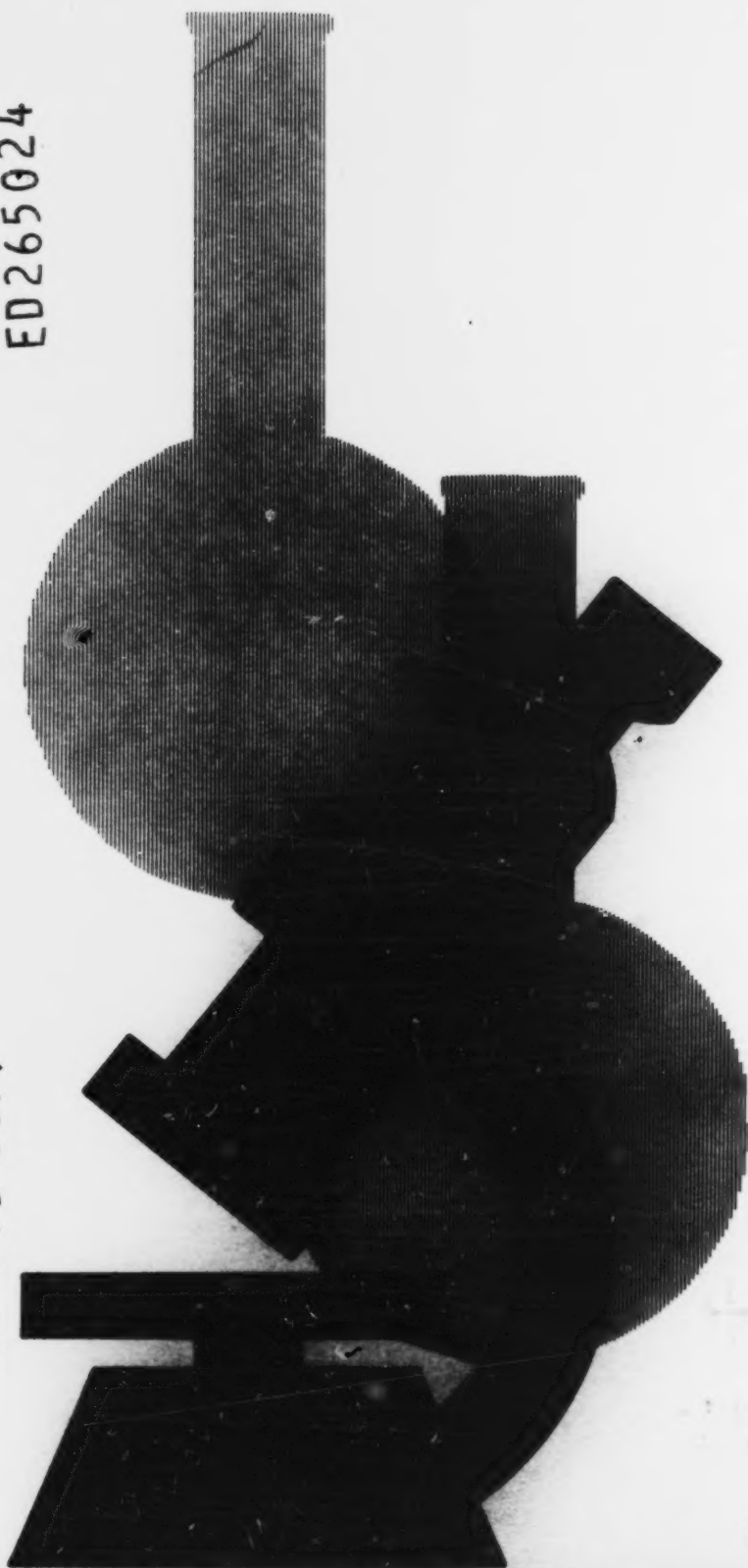
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SECONDARY SCIENCE
ALASKA CURRICULUM GUIDE

First Edition



Support of the Model Curriculum Project was provided through
a special grant from ECIA Chapter II (Block Grant)

Alaska Department of Education

August 1985

SECONDARY SCIENCE

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"Science is simple common sense at its best--that is,
rigidly accurate in observation, and merciless to
fallacy in logic."

T. H. Huxley

PREFACE TO THE SERIES

Among the many decisions that schools must make, none is more important than the choice of curriculum. Curriculum defines the intent behind instruction and the expectations for student performance. This first field edition curriculum guide is one of a series intended to serve as a model to aid school districts as they develop and review their own curriculum documents. It is not intended that any of these field edition guides be used directly by teachers for instructional purposes. Districts are expected to develop their own locally suitable curriculum based on these guides. Districts have or are developing their own locally suitable curriculum using these guides as a base and point of departure. In the future as schools use this material to plan and implement programs, its value will be measured by the increased abilities of students to learn, think, and perform as informed and productive citizens.

In their present form these guides represent a synthesis of input from many sources, both Alaskan and national. They were originally prepared by staff at the Department of Education with the help of professional content associations, Alaskan teachers and administrators. An extensive review and revision process was conducted in 1984-85. School districts, subject matter associations, other professional associations, and interested individuals provided input to a revision process that was contracted to the Northwest Regional Educational Laboratory. A panel of nationally recognized curriculum specialists assisted in the review of each content area. Contributors to specific guides are listed in the acknowledgements sections of those guides. In

one sense, these guides will never be finished. It is the intention of the Department of Education that they be dynamic documents subject to revision every few years as part of the six year curriculum review cycle that was recently initiated by new curriculum regulations. Guides exist in the areas of:

Kindergarten	Fine Arts
Language Arts	Social Studies
Science	Computer Education
Foreign Languages (Secondary)	Health
Mathematics	Physical Education

The format of the guides is straightforward but not oversimplified. Each guide lists topics/concepts, learning outcomes, and sample learning objectives in three columns. (In the case of Secondary Foreign Language, the first column is headed topics/skills.)

Topics/concepts, in the first column, describe the major parts of the subject under consideration. They define broadly the content to be included in the study of each subject area.

Learning outcomes, in the second column, describe, in general terms, the behaviors students are expected to demonstrate as a result of their learning experiences. Learning outcomes are the goals toward which student learning is directed.

Sample learning objectives, shown in the third column, are indicators of student progress toward the stated goals, i.e., the learning outcomes. At least one sample learning objective is stated for each learning outcome. It is intended that the sample learning objectives are just that: samples only. They do not constitute a learning program. School districts generate their own locally applicable learning objectives within the framework of their district topics/concepts and learning outcomes.

The guides are grouped by grade level groupings (except Mathematics) -- grades 1-3, 4-6, 7-8 for the elementary level, and 9-12 for the secondary level. Mathematics is presented sequentially grade by grade. Recognizing the unique characteristics of the five year old learner, Kindergarten was prepared as a separate guide. In the development, grades 7-8 were generally seen as the end of the elementary years, but with some beginnings for the secondary level. On the secondary level the guides generally contain discrete courses that would be offered; these are not always tied to a particular grade level as the local district must determine the most effective sequence for those courses.

The Alaska State Board of Education stated, "The Model Curriculum Guides are intended to serve as a model, not a mandate." They underscored the fact that a partnership between state and local school districts is crucial. We seek to promote individual variation while stressing the collective responsibility for educating all students in Alaska. It is in this spirit that the Department of Education welcomes the opportunity for continuous collaboration with those interested in the further development and refinement of this entire series of guides.

PREFACE TO
SECONDARY SCIENCE CURRICULUM GUIDE

The current reform movement in science, grounded in research and development, and supported by nationally recognized science educators, suggests that new models of science curriculum need to be developed that focus on interdisciplinary, problem-oriented courses designed to improve and extend a student's conception of science and demonstrate the relevance of science to society.

This new vision of science education calls for a rethinking of instructional goals based on the following:

- 1) Achievements in science and technology contribute to much of the cultural and economic uniqueness of our country.
- 2) Citizens need to be equipped, to make decisions that require an understanding of science and technology, including decisions regarding energy, health, the environment and lifestyles.
- 3) Students need lifelong learning skills to be able to help define and shape a future that is not entirely predictable.

Therefore, the purpose for developing a model science curriculum for Alaska secondary schools is to provide a set of goals, instructional objectives and choice of subject matter essential for effecting a reform of science teaching that is congruent with modern science, technology and society. The goals of science education in Alaska include the following:

- 1) To help young people become scientifically and technologically literate citizens in a high technology nation, by focusing on issues common to students in Alaska.
- 2) To help young people become active in shaping and molding the future of a modern science and technology-oriented society and state.
- 3) To help young people use science knowledge and skills in meaningful ways such as for decision making and lifelong and independent learning.
- 4) To help young people integrate science skills and knowledge into the core curriculum, and assist them in considering careers in science and technology, preparing for college.
- 5) To help young people prepare for the future in terms of science and technology-based personal and social problems that are common to the human experience.

Framework of the Guides

The Secondary Science Curriculum Guide includes General Science (grades 7-12); Physical Science (grades 7-12); Life Science (grades 7-12); Earth Science (grades 8-10); Biology (grades 10-12); Chemistry (grades 10-12); Geology (grades 10-12); and Physics (grades 10-12).

General Science represents, in addition to developmental sequencing of context matter, topics related to Science Attitudes; Cultural and Historical Context of Science; Science Methods; Problem Solving/Decision Making; Science Careers; Science Technology and Society; Scientific Processes; and People and Their Environment. These considerations have been incorporated into each separate course whenever possible.

The remaining courses reflect a natural sequencing of subject matter in addition to the cultural and historical context of that particular aspect of science education. A major focus of each course is the integration of science content and processes with the uniqueness of the Alaska environment.

For each topical area, learning outcomes are written as broad-based educational goals and which lie on a continuum of specificity. The outcomes represent a sequential flow of content matter and are based on students' developmental patterns. Sample learning objectives are given for the outcome statements, written in behavioral terms and also reflect a continuum of specificity.

The intent of the sample learning objectives is to suggest possible way students might be able to demonstrate their mastery of the learning outcomes. Local objectives should be developed for the same purpose to more accurately reflect student experiences and abilities, available resources or student needs and interests.

ACKNOWLEDGEMENTS

In preparing the Model Curriculum Guides, the Department of Education requested and received copies of curriculum materials from school districts in Alaska, the state's own Centralized Correspondence Study and other state departments of education. The department thanks the following school districts and state departments for submitting materials:

Alaska School Districts

Adak	Galena	Nenana
Anchorage	Haines	Nome
Annette Island	Iditarod	North Slope
Bristol Bay	Kenai Peninsula	Northwest Arctic
Copper River	Ketchikan	Pelican
Cordova	Klawock	Railbelt
Craig	Lower Kuskokwim	Valdez
Delta/Greely	Lower Yukon	Yakutat
Fairbanks	Matanuska-Susitna	

State Departments of Education

Alabama	Maine	South Carolina
Arizona	Minnesota	South Dakota
Arkansas	Maryland	Tennessee
California	Nebraska	Texas
Connecticut	Nevada	Utah
Delaware	New Mexico	Vermont
Florida	New York	Virginia
Idaho	North Carolina	West Virginia
Illinois	Oregon	Virgin Islands
Indiana	Rhode Island	Guam

The department appreciates the efforts of its staff who reviewed and synthesized specific content area materials which resulted in this draft Model Curriculum Guide. Contributors in secondary science included:

Ray Cox	Ray Minge
Harvey Crommett	Stacy Liddle
Al Hazleton	Phyllis Marchese

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Virginia Johnson	Donna York
Larry Klawunder	

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E. Selig
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Special thanks are due to Gloria Lerma and Andrea Levy for their cheerful and seemingly endless typing and management of details.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENCE ATTITUDES

Know how to use science as a way of learning and communicating about self, others and the environment.

Research and report on the fur seals of the Pribilof Islands including unregulated slaughter, laws to protect the seals, and the effect of hookworms on the fur seals.

Know how to use science to clarify values, examine issues, solve personal and social problems and satisfy personal curiosity.

Research and participate in a simulation covering an Alaskan issue of relevance to students such as marine mammal management, whale hunting, logging or fisheries.

Determine how many calories in his or her diet by keeping a diary of foods eaten for one week; determine how many calories are needed each day to maintain energy, appropriate body weight and internal temperature of 98.6° F; list five factors that affect the number of calories a person needs.

Understand that the practical and aesthetic contributions of science benefit his or her personal experience.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENCE ATTITUDES (Cont.)

Know how to develop, hold or express conventional or unusual ideas related to science.

Choose a local problem and prepare a solution with a plan to implement that solution.

Determine why a person who does not exercise regularly but runs two miles in one day experiences sore muscles.

Investigate and report on local transportation practices.

Know how to initiate novel and personal ideas related to science.

Survey home and school energy uses and develop a plan to conserve the amount of energy used.

Determine how to increase mileage on a snowmobile.

Diagram local community energy resources.

Find out why it is possible to eat the right number of calories and still eat poorly.

CULTURAL AND HISTORICAL
CONTEXT OF GENERAL
SCIENCE

Know significant scientific assumptions, theories, principles, laws, facts and their historical contexts.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

CULTURAL AND HISTORICAL
CONTEXT OF GENERAL
SCIENCE (Cont.)

Describe the difference between physical and chemical changes.

Define density and volume and use these ideas to solve word problems.

Illustrate the terms elements, atoms, compounds, molecules.

Show the application of the 2nd law of thermodynamics to everyday life.

SCIENCE METHODS

Know how to use the conventional language, instruments and operations of science.

Demonstrate the proper use, care and respect for a laboratory instrument appropriate to his/her grade level or course.

PROBLEM SOLVING/
DECISION MAKING

Know how to use scientific problem solving and decision making processes.

Evaluate available health information, products and skills.

Find out how much heat escapes from the classroom and compile a list of suggestions for using insulators and/or conductors to keep heat where it is most useful.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENCE CAREERS	Understand that science learnings relate to the planning and fulfilling of personal, social and career life roles.	Identify his/her goals as a social being and tell how those goals are different from the functions or goals of other social animals. Prepare a report describing how a wildlife biologist would find answers to the problem of decreasing numbers of Bighorn sheep in Alaska. Apply decision-making steps to solve a personal problem or make a career choice.
SCIENCE, TECHNOLOGY AND SOCIETY	Understand how science affects technology and how technology affects people and their everyday lives.	Prepare a report describing how the concept of work has been changed with increased automation. List some current technological innovations adopted by Native people; review traditional tools, weapons or equipment and report on the ways western materials have been adapted, such as drums with plastic covers, fish wheels or seaweed dried in clothes dryers. Role play a character involved in coastal zone or community planning.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENCE, TECHNOLOGY
AND SOCIETY (Cont.)

Describe community or coastal zone management and how it relates to a community.

Predict, describe or draw the way a community environment will look 25 years from now.

Know about some science and technology-related jobs.

Report on famous role models in science fields.

Interview local people in science-related jobs.

SCIENTIFIC PROCESSES:

Observing

Know how to use observation skills for scientific inquiry.

Observe and report on the effects of refracted light (such as fish or objects in the water which are not where they appear to be because of refracted light).

Classifying

Know how to classify objects based on scientific observation.

Classify a given set of objects as to which are conductors of electricity and which are insulators of electricity.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENTIFIC PROCESSES (Cont.)		
Using Numbers	Know how to use numbers for scientific inquiry, measurement, classification and ordering of objects.	Build a timer and use it to time a two-second interval, at which time a ball is rolled down an incline plane and the distance is measured; compute the average distance traveled and average speed of travel.
Communicating	Understand how to use various media to carry information from one person to another.	Demonstrate the behavior of waves using ropes or a spring toy such as a slinky.
Measuring	Know how to use instruments to measure and estimate.	Build a force meter and use it to measure the forces necessary to move certain objects.
Predicting	Know how to predict future observations on the basis of previous information.	Predict how the natural environment will look in 10, 20, or 50 years.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENTIFIC PROCESSES Predicting (Cont.)		Build a pulley and experiment with lifting various objects; use a spring scale to calculate the weights of objects lifted and the forces used to lift them; predict how forces would be multiplied by various pulley arrangements.
Using Time/Space Relationships	Understand spatial relationships of objects such as motion, direction, symmetry and shapes and how these relationships change with time.	
Inferring	Know how to explain an observation in terms of his/her previous experience.	Use a compass to detect the presence of a magnetic field around an electrical wire.
		Experiment with electrical circuitry by varying the voltage and the arrangement of bulbs and wires; explain results of the observation.
PEOPLE AND THEIR ENVIRONMENT	Understand the natural environment functions according to patterns of established relationships between living and nonliving things.	
		Report on the impact of and role played by the forest environment in shaping the political, economic and sociological events and behaviors of the past, present and future.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

PEOPLE AND THEIR
ENVIRONMENT (Cont.)

The Learner will:

The Learner will:

Understand that human populations grow exponentially while food production grows arithmetically.

Compare his/her caloric intake with the caloric intake of diet-deficient persons.

Locate "food priority" countries in the world and report on the causes of their hunger.

Discuss the connection between foods students like to eat and the preservation of the environment.

Understand how waste is disposed of and what ultimately happens to it.

Research how waste is disposed of in the community and suggest alternative uses for waste.

Report on the effect of waste on the environment.

Relate excessive packaging of foods to energy consumption, waste and use of resources.

Understand that individuals and private groups within society play an important role in developing public awareness of environmental issues.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

PEOPLE AND THEIR
ENVIRONMENT (Cont.)

The Learner will:

The Learner will:

Know how to develop appreciation for natural beauty and respect for all forms of life.

Research an environmental problem and create a viable solution.

Discuss how the environment is continually being shaped by naturally and humanly produced forces, which can alter the balance of conditions and lead to changes in the plants and animals.

Discuss how societies develop in diverse physical and social settings and meet the needs and desires of their members.

Understand the political, economic, social and environmental aspects of environmental issues; understand that there are many alternatives to be considered in solving environmental problems.

Identify a local environmental issue by conducting a survey of community members, newspapers and/or other media.

Understand that the lifestyles of many people in the U.S. depend on an abundance of manufactured products.

SECONDARY SCIENCE
GENERAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

PEOPLE AND THEIR
ENVIRONMENT (Cont.)

The Learner will:

The Learner will:

Understand that recreational practices
affect resource use.

List the purposes and dangers of some hazardous
chemicals.

Record and graph recreational activities for a
week.

Compare and contrast different types of
recreation.

Investigate and report on local recreational
needs.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
CULTURAL AND HISTORICAL CONTEXT OF LIFE SCIENCE	Know the major components of life science.	Describe the major components of life science including zoology, botany, genetics, microbiology, ecology.
	Know how life scientists obtain knowledge.	Design a life sciences experiment which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).
	Understand the difference between living and nonliving things.	List and describe the properties of life.
		Discuss why all biological problems are not solved.
SCIENCE CAREERS	Know about careers in life science.	

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENCE CAREERS (Cont.)		List reasons why the study of life science is important. Research and report on at least one life scientist in Alaska, including how the career relates to personal life goals. Identify learning experiences in school which have improved his or her ability to follow a particular career direction in science.
PLANT AND ANIMAL COMMUNITIES	Understand that a community is made up of interacting populations.	Define population, variations, population growth. Discuss environmental needs of various populations. Show the difference between arithmetic and exponential rates of population growth. Discuss the concept of doubling time and its relation to human population and the demand for food.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

PLANT AND ANIMAL
COMMUNITIES (Cont.)

The Learner will:

The Learner will:

Understand the roles and characteristics
of community members.

Identify the interactions that occur within a
given land community.

Classify organisms according to the role they
play in communities such as producers, consumers,
decomposers, given a photograph or slide of a
community.

Understand the factors which affect
communities.

Describe how energy from the sun is captured by
producers.

Illustrate the proper sequence of the flow of
energy from producers to consumers to decomposers.

Predict the consequences of a change in a
limiting factor such as water, light,
temperature, oxygen on a community.

Construct a mobile that demonstrates a comparison
of the amounts of energy used locally.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PLANT AND ANIMAL
COMMUNITIES (Cont.)

Understand ecosystems.

Identify the factors determining land use in Alaska and reasons for change in a given land use area; explain reasons for conflict when the use of a given land area is being decided.

Discuss the possible ecological relationships that exist in a given community.

Understand biomes.

Identify different biomes given a set of pictures, slides or a description.

Understand how plants are used.

Define "ethnobotany" and identify plants which Native people use for medicines.

Discuss how Native people use resources for food, clothing and utilitarian purposes; the techniques they developed to preserve resources; the resources used by Native people that are not commonly used by non-Natives.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PEOPLE AND THEIR
ENVIRONMENT

Understand that the interaction of
people and the environment produces
change.

Describe factors that disrupt ecosystems in
Alaska such as overpopulation and pollution.

Calculate the space necessary to dispose of a
year's supply of a plastic container (such as a
bleach bottle) from his/her community; devise a
plan to dispose of aluminum, wood, tin, iron and
glass products.

ADAPTATION

Understand reproduction.

Describe the role of DNA in heredity.

Give an example of genetic mutation and describe
how genes are affected by radiation, chemicals,
ultraviolet light and drugs.

Distinguish among examples of organisms that
reproduce asexually and those that reproduce
sexually.

Classify pictures of asexual organisms according
to their types of asexual reproduction such as
budding and sporulation.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
ADAPTATION (Cont.)	Understand survival.	Give an example of an Alaskan animal that undergoes structural changes in response to seasonal changes of climate, as part of the organism's regulative functions. Identify the major adaptations of a given set of plants and animals in Alaska which enable them to survive. Describe basic plant behavior such as phototropism, geotropism and chemotropism. Describe basic animal behavior such as courtship, aggressiveness, warning and offspring identification. Identify the dominant plant type for each major era or period when given a geological chart. Describe how some animals have changed through the ages and why these changes have occurred.
ADAPTATION OF PEOPLE	Understand the systems of the human body.	

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ADAPTATION OF PEOPLE (Cont.)

Illustrate the major structures of the human body system by drawing a man or a woman and including the following parts: skeletal, muscular, skin, digestive, respiratory, nervous, excretory, reproductive, circulatory and endocrine; describe the functions of each system.

Describe the major growth periods of a human from infancy to adult including the effect on growth of such factors as heredity, nutrition, environment, drugs.

THE CELL

Understand that the basic unit of life is the cell.

Research and report on the contributions of biologists such as Hooke, Schleiden, Swann, Watson, Crick.

Identify cells and their major parts in a variety of organisms, given pictures, microscope slides and other visuals or living material.

Demonstrate the general principles of diffusion and osmosis using standard laboratory equipment.

Examine and describe various tissues such as epithelial and muscle when given slides and a microscope.

SECONDARY SCIENCE
LIFE SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

THE CELL (Cont.)

Evaluate the moral, ethical and legal issues surrounding genetic engineering.

Order a list of ten organisms ranging from single cell organisms to human beings in proper sequence from simple to complex.

Understand mitosis and meiosis in a cell.

Identify the stages of mitosis and meiosis in cell reproduction.

Determine how energy is produced in the breakdown of ATP to ADP.

CLASSIFICATION OF ORGANISMS

Know how to group organisms according to a variety of classification schemes.

Describe the differences in one-stage, two-stage and multistage classification systems.

Identify kingdom as a major category in a taxonomy of organisms and list the subdivisions: phyla, classes, orders, families, genera, species, varieties.

Compare and contrast the five kingdoms found in most biological taxonomies: animal, plant, fungi, protista, monera.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENTIFIC METHODS

Know how physical scientists obtain knowledge.

Design an experiment in the physical sciences which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).

SCIENCE CAREERS

Learn about careers in physical science.

Research and report on careers in physical science in the U.S. including: categories (professional, paraprofessional, nonprofessional); priorities; areas of employment (R&D, management, process control, teaching); supply and demand for scientists; areas of employment for nonprofessionals and paraprofessionals.

MATTER

Know that anything which occupies space is defined as matter.

Describe properties of the three states of matter and indicate how they are interrelated.

Demonstrate that all matter occupies space and has mass.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

MATTER (Cont.)

The Learner will:

The Learner will:

Understand the general atomic structure of matter.

Draw or construct models of elements showing electrons, protons, neutron positions and give names of some common elements.

Compare the properties of common elements when given several examples.

Draw a model illustrating differences between the common atom of an element and its isotope(s) when given the name of a common element and appropriate data.

Define the terms: elements, atoms, compounds, molecules.

Understand the basics of nuclear energy.

Compare and contrast the concepts of nuclear fission and fusion.

Explain the general principles and components of a nuclear reactor.

Evaluate the pros and cons of nuclear power and give support for the position taken.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MATTER (Cont.)

List some useful applications of radioactive isotopes in industry, agriculture, and medicine.

Describe, using numbers, the three factors in protecting oneself from exposure to radiation: time, distance, and intensity.

Discuss and role play a plan of action to protect a community from radiation.

ENERGY

Understand the concept of work.

Identify work and nonwork situations from a list of examples.

Give an example that illustrates energy as the ability to do work.

Distinguish between potential and kinetic energy.

Give examples of different kinds of energy such as chemical, heat, electrical, mechanical.

Demonstrate knowledge of energy sources in Alaska, their limitations (finiteness) and how people in Alaska can conserve energy.

Draw six simple machines.

Calculate power and velocity of a moving object, given a word problem.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ENERGY (Cont.)

Understand gravitational force.

Design an experiment to demonstrate one of Newton's three laws of motion.

Make a report on the contributions of Galileo and Newton to the understanding of gravity.

Describe the changes in gravitational force acting on two objects as (1) the distance between them is changed and (2) the mass of one object increases while the distance remains the same.

Demonstrate centripetal force.

Describe fluid pressure and identify instruments used to measure pressure; describe how these instruments work.

Determine the density of a common object given a balance, weights, and appropriate measuring instruments.

Demonstrate how lift is provided to an airplane.

Understand electricity and magnetism.

Describe the interaction of two oppositely charged objects with respect to attraction or repulsion.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

The Learner will:

ENERGY (Cont.)

SAMPLE LEARNING OBJECTIVE

The Learner will:

Identify conductors and insulators from a list of objects.

Demonstrate the patterns of magnetic lines of force when given a bar magnet and iron filings.

Construct a model showing the correct orientation of atoms in a magnet.

Make an electromagnet.

Make a diagram showing how increasing the voltage in a circuit will affect the amperage.

Solve for any one variable, using Ohm's law, when given a word problem involving voltage, ohms and amperage.

Make an electric motor.

Compute the voltage when cells are connective in parallel or in a series when given wire, three dry cells and a voltmeter.

Describe the functions of rectifiers and transformers.

Demonstrate a chemical reaction that produces electricity.

Determine the number of kilowatt-hours consumed, given a diagram of the dial(s) on an electric meter.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ENERGY (Cont.)

Understand wave energy.

Calculate the cost of electrical energy of the classroom, school, town or village given the kilowatt-hour rates and electric meter readings for two consecutive months.

Develop a plan to conserve electrical energy in his/her home, school, village or town.

Describe transverse and longitudinal waves.

Explain how energy is transferred in a wave.

Describe how sound waves are produced and list their basic characteristics.

Identify three ways waves travel.

Make a diagram or physical model showing the effects of concave and convex lenses on light waves.

Understand heat energy.

Describe the difference between heat and temperature.

Solve a heat problem, using calorie as a measure of heat in the calculations.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
ENERGY (Cont.)		Design an experiment to measure the amount of heat lost or gained. Define conduction, convection and radiation.
INORGANIC CHEMISTRY	Understand the periodic chart of elements.	Identify the major characteristics of selected elements using a periodic chart. Describe the general arrangement of the periodic table such as families, period and activity. Draw atoms with electron configurations, given a list of common elements and a periodic chart. Define compounds, mixtures and elements and give examples of each. Illustrate examples of chemical reactions using symbols and formulas. Determine the valence(s) of selected common elements, given a periodic chart. Describe basic characteristics of acids, bases, salts and give examples of each. Design an experiment to determine a true solution.

SECONDARY SCIENCE
PHYSICAL SCIENCE
GRADES 7 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

INORGANIC CHEMISTRY (Cont.)

Understand how density of each element
is different and a measure compared to
water.

Solve problems of density given volume and mass.

Determine density of different irregular objects.

ORGANIC CHEMISTRY

Understand compounds.

List examples of common organic compounds.

Describe the role of prehistoric plants and
animals in the formation of hydrocarbon compounds.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENTIFIC METHODS

Know how earth scientists obtain knowledge.

Design an experiment in the earth sciences which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).

CAREERS IN EARTH
SCIENCE

Know about careers in earth science.

Research and report on careers in earth science in the U.S. and specifically in Alaska, including astronomers, geologists, meteorologists, climatologists and oceanographers and the impact these persons have made on life in Alaska.

Explain how various branches of the earth sciences relate to one another.

Interview local people in science-related jobs.

THE SOLAR SYSTEM
AND SPACE

Understand the relationship of earth and space.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

THE SOLAR SYSTEM
AND SPACE (Cont.)

The Learner will:

The Learner will:

Understand astronomy as the study of solid and gaseous bodies in space and their interrelationships.

Make a presentation demonstrating that the earth is essentially a sphere using such techniques as satellite photography, earth's shadow on the moon, etc.

Demonstrate the earth's motion in space using the stars and heavenly bodies as part of the demonstration; explain how day and night and the seasons result from this motion.

Demonstrate how the earth's motion in space is used to establish latitude, longitude and time.

Report on the contributions of famous and current astronomers.

Describe how the study of astronomy is constantly changing as more sophisticated instruments and techniques are developed.

Discuss how people throughout history have tried to explain what they see in the sky through myths, legends and stories.

Describe some astronomical discoveries and concepts from various ancient civilizations such as Chinese, Egyptian, Babylonian, Greek and the factors which affected the development of these discoveries such as technology, cultural beliefs and economics.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

THE SOLAR SYSTEM
AND SPACE (Cont.)

The Learner will:

The Learner will:

Know some of the theories about how and when the universe began.

Relate principles, laws, theories and discoveries developed in other sciences to the science of astronomy; for example, contributions of mathematicians and physicists.

Understand galaxies as a part of the universe.

Describe "Big Bang", "Pulsating" and "Steady State" theories regarding the origin of the universe.

Compare and contrast scientific theory and cultural or religious beliefs.

Know that our solar system is a part of the Milky Way Galaxy.

List the characteristics of galaxies.

Describe the four main kinds of galaxies: barred, irregular, spiral, elliptical.

Illustrate the relationship between our solar system and the Milky Way galaxy.

Describe "black hole".

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
THE SOLAR SYSTEM AND SPACE (Cont.)	Understand that constellations are a group of stars that appear to form a pattern in the sky.	Identify, list the names and relative positions of selected constellations.
		Explain the role of constellations in ancient navigation, in attempts to predict the future and in mythology.
		Define nebula.
	Understand basic properties of stars.	Give the properties of stars including size, mass, luminosity, temperature, color and life span.
		List the significant stars in our solar system: Polaris, Vega, Sirius, Alpha, Centauri, Proxima Centauri, and explain their significance.
		Explain that differing stellar spectra are due to differences in temperature rather than differences in chemical composition.
	Understand the role of the sun in our solar system.	Describe the sun as a star of average size, mass, absolute brightness and temperature as compared to other stars.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

THE SOLAR SYSTEM
AND SPACE (Cont.)

The Learner will:

The Learner will:

Know the name and location of other planets in our solar system.

Design and construct instruments for determining the position of the sun.

Illustrate the sun's movement.

Give the relative position of the earth, moon and sun during a solar eclipse.

Explain sun spots.

List and describe the three designated layers of the sun: photosphere, chromosphere, corona.

Know that there are definite patterns to the motion of the moon in relation to the sun or the planets.

Give the general characteristics of each of the nine planets including length of days and years, chemical composition of the atmosphere, number of moons, sizes and distances from the sun.

Explain how the existence of planets can be predicted before they are discovered.

Name the phases of the moon, and describe the appearance of the moon in each phase.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

THE SOLAR SYSTEM
AND SPACE (Cont.)

The Learner will:

The Learner will:

Understand the purposes of man-made
satellites.

Give the relative positions of the earth, moon
and sun during a lunar eclipse.

Illustrate the moon phases and eclipses using
models.

List at least seven purposes for the uses of
satellites.

Explain the scientific principles, laws and
theories on which satellite research and
development are based.

List and explain some problems associated with
the use of satellites.

Understand comets, meteoroids and
asteroids.

Explain how a comet's path can be mapped and
predicted.

Give some theories as to the origin of comets.

Illustrate the orbit of a comet around the sun.

Define meteoroids, meteorites and asteroids.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

THE SOLAR SYSTEM
AND SPACE (Cont.)

Give the composition of three kinds of meteorites.

EARTH HISTORY

Know that geologic history is classified
into epochs, periods and eras.

Give names of the geologic eras and their
distinguishing characteristics.

Explain how the eras of geologic time were
determined by the strata and dominant life forms
thought to exist at the time.

Illustrate the development of life on earth
during specific time periods.

List some of the major geological events that
have taken place in Alaska and give their proper
place in the sequence of geological time.

Find geological evidence that climatic changes
have taken place in Alaska.

Explain and illustrate sequential dating of rock.

Give the geologic time scale for Alaska.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
EARTH HISTORY (Cont.)	Understand the theory of evolution.	Explain how some life forms developed variations in order to adapt to changes in the environment. Report on the role of fossil evidence of past life forms to the theory of evolution. Give some theories or hypotheses as to why some life forms became extinct. List some geologic events which may have influenced the development and distribution of human population. Report on the work of Darwin, Andrews, Dart and Leakey.
	Understand the processes and conditions under which fossils were formed.	List and describe the ways in which fossils were formed. Explain how fossils are used by humans. Explain how fossils are named and classified. Identify invertebrate and vertebrate fossils.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EARTH ENVIRONMENTS:
SOIL

Understand soil as a part of the earth's environment.

List and describe the ways in which plant decay and animal activity make fertile topsoil.

Find examples of soil erosion in the community; describe the role of water, wind and human activities in that erosion.

Explain how plant roots prevent soil erosion; list other ways to prevent soil erosion and maintain nutrient content.

List the factors to be considered in determining land use capabilities.

Explain how the amount of moisture in the soil is related to the rate of decay and formation of humus.

Make a plan for conservation of soil.

EARTH ENVIRONMENTS:
WATER

Understand water as a part of the earth's environment.

Explain how watershed regions are damaged.

Describe methods of flood control.

List the chief causes of water pollution.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
EARTH ENVIRONMENTS: WATER (Cont.)		Relate the amount of oxygen in water to the amount of animal life present. Determine the oxygen content, and acidity and living organisms present in water samples. Describe ancient and modern irrigation systems. Research and report on methods used in the community or state to prevent water pollution and to recycle water.
EARTH ENVIRONMENTS: AIR	Understand air as a part of the earth's environment. Understand basic characteristics of the earth's atmosphere.	Give examples of air pollution in the community and/or other areas of the state and its effects. List the chief causes of air pollution. Research and report on how air is tested to determine the amount of pollutants present. Describe the effects of temperature inversion on the quality of air.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EARTH ENVIRONMENTS:
AIR (Cont.)

Explain the theory that the atmosphere gradually developed from poisonous gases through photosynthesis and development of an oxidizing atmosphere.

Describe the earth's atmosphere, including troposphere, stratosphere and ionosphere.

Explain how radiation of long wave lengths regulate temperature (greenhouse effect).

Explain how light energy is converted into heat energy in the atmosphere.

EARTH ENVIRONMENTS:
WEATHER

Understand basic principles of weather.

Demonstrate the use of mercurial and aneroid barometers, barographs and altimeters.

Measure air pressure.

List the mixture of gases in air.

Explain why warm air rises and cold air sinks.

Illustrate the relationship of vertical air movements to temperature, pressure and density.

Explain how different forces and velocities of winds are produced.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

EARTH ENVIRONMENTS:
WEATHER (Cont.)

The Learner will:

The Learner will:

List the causes and effects of temperature inversions.

Define moisture, humidity, relative humidity and dew point.

Explain the cause/effect relationship between atmosphere and weather.

Make a diagram to explain how air temperature is related to light energy and cloud cover.

Demonstrate air movement; show how air masses affect weather conditions in Alaska.

Demonstrate how clouds are formed; relate the type of cloud to circulation conditions in the atmosphere.

Make a chart showing how different types of precipitation form under different temperature conditions.

Describe how cyclones and anticyclones are formed and trace the life cycle of a cyclone across the U.S. using standard weather maps and symbols.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EARTH ENVIRONMENTS:
WEATHER (Cont.)

Understand local weather patterns and
people interactions.

Explain how weather follows natural laws and
therefore, can be predicted.

Demonstrate how common atmospheric properties are
measured using the following instruments:
thermometer, hydrometer, anemometer, rain gauge.

Make a weather guide with old-time rhymes and
sayings.

Track a storm.

Predict, record and graph local weather
conditions.

Test for air particulates and acid rain in the
community.

EARTH ENVIRONMENTS:
CLIMATES

Understand basic principles of climate.

Explain the difference between weather and
climate.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EARTH ENVIRONMENTS:
CLIMATES (Cont.)

Give examples of weather phenomena that are repeated periodically forming a climatic zone.

Give examples of climates that are altered by geography.

Illustrate the major climates of the U.S.

Define microclimates in terms of physical factors and biological factors.

Explain how common atmospheric pollutants such as industrial fumes and automobile exhaust affect plants, animals and the physical environment; determine the effect of pollutants on Alaska's environment.

Explain how climate in certain areas affects humans, such as the arctic, the tropics or a desert.

EARTH ENVIRONMENTS:
OCEANS

Understand oceanography as a science discipline.

Define oceanography.

Relate oceanography to geology, chemistry, physics, biology, meteorology, astronomy, mathematics.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

EARTH ENVIRONMENTS:
OCEANS (Cont.)

The Learner will:

The Learner will:

Understand basic characteristics of the
earth's oceans.

Report on the professional life of an
oceanographer, including how different scientific
disciplines such as geology and biology are
applied to the study of oceans.

Describe how improved technology has changed the
science of oceanography.

Describe the basic causes and patterns of ocean
circulation including major ocean currents such
as the Gulf Stream and the Labrador Current.

Explain how planetary rotation, prevailing winds,
gravity and other forces affect ocean currents.

Design a model showing major physiographic
features of ocean basins such as ridges,
trenches, continental shelves.

Explain how Alaska's coastal landscape has
changed as a result of waves, tides, currents,
winds and tectonic action.

Understand structure and composition
of the ocean basins.

List and describe the names and characteristics
of major structures of ocean basins.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

EARTH ENVIRONMENTS:
OCEANS (Cont.)

The Learner will:

The Learner will:

Understand ocean currents and
circulatory processes.

Use correct terms for ocean bottom features
topographic zones, etc.

Name and give approximate proportions of the
chemical composition of seawater.

Describe the effects of salinity on living things
in the ocean.

Determine the density of seawater.

Name and give the characteristics of various
kinds of ocean currents and ocean circulatory
processes.

Define crest, trough, height, wave length,
period, whitecap, swell, breaker, undertow, rip
current, long shore current, refraction as they
relate to waves.

List the factors that affect wave height and the
speed of waves.

Demonstrate how tides are created.

Give the shoreline characteristics that affect
wave magnitude and rhythm.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

EARTH ENVIRONMENTS:
OCEANS (Cont.)

The Learner will:

The Learner will:

Understand shorelines and the effects
of erosion on shorelines.

Explain how tides are used to generate
electricity. Measure speed, period and wave
lengths of water waves.

Give some examples of different types of waves and
their characteristics.

Explain the erosional and depositional effect of
waves on shorelines.

List shoreline land forms made by deposition or
erosion.

Define neutral, submergent and emergent
shorelines.

Give the structural characteristics of islands,
reefs, swamps, deltas, estuaries, bays, tide
flats.

Predict changes in shorelines due to wave energy
and direction, depth of water and sediment supply.

Explain how jetties and breakwaters change
shoreline processes.

Know about life in the ocean.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

EARTH ENVIRONMENTS:
OCEANS (Cont.)

The Learner will:

The Learner will:

Explain that the majority of sea life exists over the continental shelf and in areas of upwelling; explain why other parts of the ocean are almost devoid of life.

List the physical factors that affect distribution of life in the ocean.

List simple organisms that live in seawater.

Define Pelagic and Benthos.

Give examples of animal life in the ocean; give examples of birds that live at sea.

Explain the elements and processes of the food web in the sea.

Define predation and regulation as they relate to the food web.

Understand the effects of human activities on the ocean.

Evaluate the ways in which humans use oceans or marine land forms as natural resources.

SECONDARY SCIENCE
EARTH SCIENCE
GRADES 8 - 10

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EARTH ENVIRONMENTS:
OCEANS (Cont.)

Describe ways in which various kinds of pollution affect marine life.

Describe ways in which technological experimentation affects marine life.

Research and report on current issues related to use or conservation of marine resources, pollution of marine life, etc.

Analyze issues related to human influences on marine life.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENTIFIC METHODS

Know how biologists obtain knowledge.

Design an experiment in the biological sciences which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).

SCIENCE CAREERS

Know about careers in biology.

Research and report on at least two of the following careers in the biological sciences: botany, zoology, microbiology, anatomy, cytology, ecology, embryology, genetics, histology, limnology, morphology, pathology, physiology.

Report on the current demand for paraprofessionals in the biological sciences.

THE CELL

Understand the cell as a basic building block of life.

Explain that all living things are either composed of one or more cells, or dependent on cells for their existence (viruses, etc.).

Describe cells as being composed of elements from the earth's atmosphere and crust.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
THE CELL (Cont.)	Know how organisms are built.	Describe unicellular organisms; multicellular organisms.
	Understand basic cell structure.	Differentiate living cells from nonliving matter.
		Illustrate parts of a generalized plant or animal cell.
		Prepare materials to be seen through a microscope.
		Use a microscope to examine cells.
		Recognize the major parts of a cell through a microscope.
	Understand general cell function.	Define metabolism, reproduction, response.
		Describe how cells reproduce themselves.
		Explain the effects of viruses, chemical poisons, and radiation on cells.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

THE CELL (Cont.)

Understand how cellular material is transported.

Explain the difference between total permeability, impermeability and selective permeability.

Define and give examples of diffusion and osmosis.

Describe how substances move through cell membranes.

Understand cell metabolism.

List the materials required by cells to maintain life.

Define bond energy.

Measure the amount of carbon dioxide produced by a living system.

Explain how life processes obtain their energy requirements.

Calculate the rate of respiration of a cell from measurements of its rate of CO₂ evolution.

Illustrate chemical reactions using models of molecules.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

Understand genetics.

Explain the transcription of DNA information into protein.

Describe the role of chromosomes in sexual reproduction, including why offspring are similar to or dissimilar from their parents.

Evaluate the implications of modern genetic technology.

Explain organic variances and their importance within a population given a population case study; describe organic variation in relation to mutations.

MICROBIOLOGY

Understand basic characteristics and functions of viruses and bacteria.

Classify different types of bacteria by shape.

Identify from a list of familiar diseases those caused by viruses or bacteria.

Evaluate the use of viruses and bacteria by industry and research.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MICROBIOLOGY (Cont.)

Understand basic characteristics and functions of protozoans.

Label and describe the functions of the major organelles of a typical protozoan.

Construct a food chain showing the role of protozoans.

Understand basic characteristics and functions of algae.

Define algae, list examples, and describe how algae are important to people.

INVERTEBRATES ,

Understand the structure and function of sponges.

Contrast sponges with other invertebrates to explain why sponges are considered the simplest form of invertebrates.

Explain the importance of sponges to people.

Understand the structure and function of coelenterates.

Report on the characteristics of coelenterates including their importance to people.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

INVERTEBRATES (Cont.)

Understand the structure and function of flatworms and roundworms.

Report on the characteristics of flatworms and roundworms, including their importance to people.

Understand the structure and function of mollusks.

Identify mollusks given a list of animals; describe their importance to people.

Understand the structure and function of annelids.

Label and describe the functions of the major organs of an annelid, given a diagram of an earthworm.

Describe the effect of annelids on people.

List the advantages of body segmentation.

Understand the structure and function of arthropods.

Group arthropods into five classes, given examples.

Describe the importance of arthropods to people.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
INVERTEBRATES (Cont.)	Understand the structure and function of echinoderms.	List advantages and disadvantages of radial symmetry.
	Understand bilateral symmetry.	List ways echinoderms affect people.
VERTEBRATES	Understand the general characteristics of vertebrates.	List advantages of specialization related to specific organisms.
	Understand the structure and function of fishes.	Describe the role of evolution to the advancement of organ systems in vertebrates.
		Explain the relationship between the common characteristics of primitive vertebrates and their environment.
		Identify the three classes of fishes and give examples of fish native to Alaska.
		Draw a fish showing the external and internal features; describe the function of each.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
VERTEBRATES (Cont.)		Explain the effect of fish on people.
	Understand the structure and function of amphibians.	Compare and contrast the characteristics of amphibians with characteristics of other vertebrates.
		Explain why amphibians are considered transitional animals between water and land.
		Draw a diagram showing the evolution of amphibians.
		Describe the importance of amphibians to people.
	Understand the structure and function of reptiles.	Compare and contrast reptile characteristics with characteristics of other vertebrates.
	Understand the structure and function of birds.	Identify characteristics common to birds including special adaptations which enable them to fly.
		List ways birds have affected people.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

THE STUDY OF HUMANS

Understand the nature of human origin and development.

Describe the functions of DNA, RNA, chromosomes and genes.

Defend a specific theory of human origin and development with supporting evidence.

Analyze a family tree in terms of genetic traits.

Understand human anatomy.

Label and describe the major organs of each system of the human body.

Describe the prenatal development of humans.

Understand human physiology.

Explain how the human body is regulated, given a list of organs or glands.

Discuss the effects of diseases (nutritional, pathogenic, genetic) on the physiology of the human body.

Discuss the effects of chemicals on human reproduction functioning.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

THE STUDY OF HUMANS (Cont.)

Understand human behavior.

Distinguish between voluntary and involuntary responses.

Summarize current research related to learned and unlearned behavior in humans.

Explain the relationships among an individual's knowledge; mental, social and technical skills; values; and behavior.

Discuss social, personal or academic issues related to regulation and control of human behavior.

Describe how human behavior is affected by various chemicals.

Know the implications of social/ethical biology.

Evaluate such contemporary issues as birth control and venereal disease.

Assess the consequences of the use of alcohol, narcotics and tobacco.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ECOLOGY

Understand the nature of populations, communities and ecosystems.

Describe the interactions of members of the biotic community, given a sample ecosystem.

Compare and contrast biotic and abiotic parts of an ecosystem.

Trace the energy flow within a sample ecosystem.

Know how humans affect their environment.

Evaluate moral and ethical issues such as world hunger, population control, alternate energy sources, pollution control, world resource allocation and endangered species.

PLANTS

Understand photosynthesis.

Define photosynthesis and list its products.

List the materials required for photosynthesis.

Give the sequence of chemical reactions involved in photosynthesis.

List the factors that affect the rate of photosynthesis.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PLANTS (Cont.)

Know names and structural characteristics of major categories of plant tissues and plant organs.

Identify parts of common plants from observation or pictures.

Identify reproductive organs common to major groups of plants (conifers, flower bearing plants).

Group or classify seeds, flowers, fruit and cones by structural similarities and differences.

Describe the process by which plant tissues and organs grow into mature plants when cut and replanted.

Describe the structural characteristics of reproductive plant tissues.

Make a diagram showing internal and external structures common to seeds.

Identify parts of a flower and describe the function of each part.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PLANTS (Cont.)

Understand plant reproduction and development.

Use laboratory instruments and techniques to demonstrate dissection, slide preparation and microscopic examination.

Identify and classify plant tissues from laboratory observations, illustrations or descriptive data.

Define gametophyte, sporophyte, zygote, gamete.

Identify reproduction parts, structure in which meiosis occurs and sequence of the alternation of generations in algae, mosses, ferns and flowering plants.

Describe pollination and the plant structure involved.

Design an experiment to test the effects of moisture, temperature, oxygen or light on seed germination and seedling growth.

Describe the steps in fruit development and maturation.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PLANTS (Cont.)

Know how to classify plants.

Grow a plant from a cutting.

Classify organisms as moneran, protist, plant or animal.

Define genotype and phenotype.

Use a taxonomic key to identify names of observed plant organisms.

Establish criteria such as size, color, age, habitat, use by humans, etc. to group and classify plant organisms.

Identify structural characteristics which distinguish various classes, orders, families, genera, species and varieties within a phylum (e.g., monocots, dicots).

ANIMALS

Know the major organs and complex tissues of animals.

Give the names and structural characteristics of major categories of animal organs and tissues.

Identify digestive and reproductive organs of various animal organisms.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ANIMALS (Cont.)

Understand reproduction and development
in animals.

Identify sensory organs and tissues of animals.

Identify major parts of an animal's locomotive
system.

Collect animal tracks and make inferences
regarding the characteristics of those animals.

Classify major systems in animals by functions
(digestive, respiratory, circulatory, regulative,
locomotive, sensory, reproductive, supportive).

Describe reproductive structures and functions of
egg-laying animals, marsupials and mammals.

Describe how animal reproduction differs from
plant reproduction.

Correlate animal homes with their inhabitants.

Use terms associated with various stages of
animal development: e.g., embryo, fetus, baby,
adult larva, pupa, maturity.

Describe the basic life cycles of reptiles,
insects, amphibians, mammals, birds, fish.

Define metamorphosis.

SECONDARY SCIENCE
BIOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ANIMALS (Cont.)

Know how to classify animals.

Identify the characteristics which distinguish the various subkingdoms and phyla of major kingdoms of organisms.

Explain how taxonomic keys are used.

Classify organisms according to conventional taxonomic categories from observations, illustrations or descriptions.

Construct a classification scheme, grouping organisms according to personally defined criteria.

Make a list of animals that are classified as endangered species.

Give the common names of various prehistoric animals.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENCE METHODS

Know how chemists obtain knowledge.

Design an experiment in chemistry which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).

Know when and how to use scientific notation.

Design an experiment and record the results using scientific notation.

SCIENCE CAREERS

Know about careers in chemistry.

Research and report on people (both past and present) who have made outstanding contributions to society through their work in chemistry.

Understand safety procedures in the laboratory.

Demonstrate correct safety procedures in carrying out an experiment in chemistry.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

MATTER AND ENERGY

The Learner will:

Understand concepts and properties of matter and energy.

Know how to conserve matter and energy.

Understand how to use measuring devices.

Know how to classify matter.

The Learner will:

Design an experiment to demonstrate the physical properties of matter such as linear dimensions, volume, weight, mass freezing point, boiling point, malleability, shapes, density, specific gravity.

Design an experiment to demonstrate the law of conservation of matter.

Mass objects and record the mass properly, within the precision of the equipment available and using a balance.

Demonstrate appropriate use of containers, flasks, cylinders and beakers for the purpose of measurement.

Classify samples of matter as (1) solids, liquids, gases; (2) colored, colorless; and (3) shiny, dull.

Classify samples of matter as elements, compounds or mixtures.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
MATTER AND ENERGY (Cont.)	Understand the laws of definite proportions and multiple proportions.	Design an experiment to determine the formula of a compound.
	Understand physical changes of matter.	Determine the melting point of a chemical in the laboratory by graphing and interpreting the temperature/time data.
		Describe changes such as endothermic and exothermic reactions, kindling temperatures, spontaneous burning, and conditions necessary for combustion and oxidation.
		Explain nuclear change and give examples.
	Understand chemical bonding.	Define the terms ionic, covalent, metallic, as they relate to chemical bonding.
	Understand atomic theory.	Summarize the experiments and contributions of those persons recognized as outstanding contributors to the development of atomic theory.
		Describe currently acceptable models of the atom such as the Bohr or quantum mechanic models.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MATTER AND ENERGY (Cont.)

Understand the law of gases.

Demonstrate the laws involving gases and their relationship expressed by Boyle's law, Charles' law, Dalton's law of partial pressures, Gay-Lussac's law, Graham's law and the Ideal Gas Law.

Explain the behavior of gases in terms of Boyle's Law, Charles' Law and Dalton's Law.

Calculate unknowns for gas equations.

Calculate mass, moles or volume of any gaseous product or reactant from a chemical equation.

Understand that atoms have a combining capacity when forming compounds.

Compute the ratio for the atoms in a compound when given the weights of various elements; determine the empirical and molecular formulas.

Compute the percentage composition by mass of atoms in compounds.

Know how to use chemical symbols, formulas and equations.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MATTER AND ENERGY (Cont.)

Understand moles.

Write the symbols for the common elements.

Write formulas and name compounds using valence numbers of ions and radicals.

Understand the relationship between matter and energy for both chemical and physical changes.

Calculate the mass, mole, atoms or molecules for any reactant or products from the corresponding mass, moles, atoms or molecules of any member of the chemical reaction.

Discover the net energy effects (exothermic/endothermic) of various reactions such as combustion, acid base neutralization, reaction of a metal with an acid, and decomposition through a series of experiments.

Understand reaction rates.

Demonstrate and explain the effects of temperature, surface area, catalysts and other factors on reaction rates.

Understand dynamic equilibrium.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MATTER AND ENERGY (Cont.)

Know how to identify the oxidation and reduction components of chemical reactions and balance selected redox equations.

Demonstrate and explain the effect that changes in temperature, concentration and pressure have on the extent and direction of a chemical reaction.

Understand the arrangement of data in the periodic table.

Demonstrate the electron transfer (oxidation number) method.

Explain families and periods; identify the main groups of the representative elements and family characteristics in a periodic table.

Explain the use of the following: rows, columns, families, periods, metals, nonmetals, metalloids, general reactivity, electronic configuration, relative atomic and ion size, ionization energy, electronegativity.

Understand acids, bases and salts.

Identify ways each common acid, base or salt on a list may be used in the home or in industry.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MATTER AND ENERGY (Cont.)

Understand the atomic structure and bonding behavior of carbon.

Identify a chemical formula for each of a variety of simple acids, bases, and salts.

Conduct experiments to determine the pH, effect of litmus paper and other physical characteristics of acids, bases, and salts.

State definitions of acids and bases according to the theories of Arrhenius, Bronsted-Lowry, and Lewis.

Use phenolphthalein to demonstrate acid-base neutrality.

Build or sketch isomers for each formula, given a set of balls and stick components and several simple molecular formulas of carbon compounds.

Demonstrate bonding.

Understand hydrocarbons.

Build the simplest members of the alkanes, alkenes, alkynes and ring compounds that comprise the hydrocarbons, using a model building set.

Explain how various hydrocarbon substitution products are formed.

SECONDARY SCIENCE
CHEMISTRY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
MATTER AND ENERGY (Cont.)	Understand biochemical compounds.	Illustrate characteristics of hydrocarbons through lab experiments. List groups of simple biochemical compounds such as fats, proteins and carbohydrates. Describe major biochemical reactions which occur in living things such as digestion, photosynthesis, cellular metabolism.
ENVIRONMENTAL CHEMISTRY	Understand how the quality of air is affected by burning gases. Understand the effects of hazardous waste on the environment.	Demonstrate how the quality of air is affected by burning gases by solving chemical equations; illustrate the products of the reactions and effects of those reactions on products. Explain hazardous waste chemistry and give examples.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SCIENCE METHODS

Know how geologists obtain knowledge.

Design an experiment in the geologic sciences which uses at least three of the scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).

CULTURAL AND HISTORICAL
CONTEXT OF GEOLOGY

Know how to relate geology to other physical sciences.

Describe geology as the science of earth, its processes, its forms and its relationships to other physical sciences.

List some subdisciplines of geology such as geophysics, historical geology, paleontology, stratigraphy, mineralogy, seismology, engineering and mining.

Discuss historical developments, discoveries and uses of the geologic sciences.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENCE CAREERS	Know about careers in geology.	Report on the interaction of research and development, management, process control and teaching in the geologic sciences.
STRUCTURE OF THE EARTH	Understand the dynamics that have affected the earth's structure.	Use appropriate units of measurement to determine the length, volume and mass of the earth's structure.
	Know the characteristics of the earth's interior.	List some physical laws, principles and theories about energy-mass as they relate to the study of earth dynamics, earth structure and geologic processes.
		List and describe the main layers of the earth's interior.
		Give the chemical composition, state of matter and relative thickness for each of the earth's interior layers.
		Make a diagram showing the earth's interior structure.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

STRUCTURE OF THE EARTH
(Cont.)

The Learner will:

Know characteristics of the earth's crust.

Know the surface features of the earth's crust.

The Learner will:

Define "plates" and "plate tectonics".

Describe the properties which distinguish the earth's crust from other layers.

Describe the composition of chemicals in the earth's crust.

Explain how scientists acquire, represent and interpret information about surface features of the earth.

Define continent, land mass, ocean, sea.

Give the characteristics of land and water formations including hills, mountain ranges, valleys, plains, plateaus, rivers, bays, islands.

Describe various types of maps and models used to represent the earth's surface features.

Interpret land and water formations from maps or models including sizes, shape, depth, elevation, distance, etc.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ROCKS AND MINERALS

Understand the effects of erosion.

Choose a topographic feature of Alaska and describe its formation, evolution and erosional form.

Understand that earth materials behave according to basic natural laws.

Explain how general properties of earth materials are determined by the kind and arrangement of the atoms comprising the materials.

Describe the major events which make up the geologic history of Alaska.

Explain the role of fossil records in earth history.

Understand the origin and history of rocks.

Describe the processes which form igneous rocks and give examples of the igneous rock types which form as a result.

Describe and give examples of the principal land forms resulting from igneous processes.

Explain the theory of uniformitarianism, including radioactive decay.

Explain the process of lithification and its relationship to sedimentary rocks.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ROCKS AND MINERALS (Cont.)

Understand the process of weathering.

Find examples of sedimentary and metamorphic rocks during a field trip.

Explain several processes by which fossils are preserved in sediments or sedimentary rocks.

Explain the basic changes that take place during metamorphism of a rock and distinguish between contact and regional processes.

Explain the difference between and give examples of physical and chemical weathering.

Describe several common chemical weathering reactions and explain how the resulting products differ from the original material.

Explain the relationship of weathering to mature soil.

Know the physical properties common to soil.

Classify soil by color, porosity, origin, location, chemical composition.

Define tundra, podsol, chernozem, sierzem, lateritic, clay, humus, loess, sand, duff, litter.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ROCKS AND MINERALS (Cont.)

Understand the basic structure and function of water.

Design a model showing water tables, springs, lakes, swamps for a specific area or region of Alaska; explain permeability.

Describe and illustrate stream features and erosion processes in youthful, mature, old age and rejuvenated streams.

Report on glacial erosion in Alaska.

Understand vulcanism.

Define vulcanism.

Explain the relationship among vulcanism, earthquakes and mountain building.

Give the characteristics of volcanic materials such as magma, lava, dust, cinders, ash, bomb, block.

Explain the theories related to the causes of vulcanism.

Define intrusive and extrusive rocks and list rock types related to their activity.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ROCKS AND MINERALS (Cont.)

Know the effect of crustal movement.

Explain how earthquakes are caused.

Make a model showing the cause of earthquakes and explain the effect of earthquakes on people.

Interpret seismographic data.

Explain the theory of plate tectonics.

Describe the characteristics of land forms created by tectonic activity.

Explain the difference among, and give examples of, youthful, mature and old age land forms.

GEOLOGIC TIME

Know how to classify geologic history.

Define epochs, periods and eras.

Give the names and characteristics of the geologic eras.

Describe the development of life on earth during specific time periods.

Find geological evidence that climatic changes have occurred in the community.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

EVOLUTION

Understand change through time.

Explain the role of fossil evidence to the theory of evolution.

Describe how some life forms developed variations to adapt to their environment.

Explain how geologic events affected the variation in evolution of life forms.

Report on possible causes of animal extinctions.

Explain the scientific theories and hypotheses related to the evolution of humans.

Describe how past geologic events influenced the development of humans and where they chose to live.

FOSSILS

Understand how fossils have contributed to our knowledge of changes that have taken place on earth.

Describe the processes and conditions under which fossils were formed.

Explain how fossils are used by humans.

Determine past climatic conditions of fossils.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

FOSSILS

Demonstrate fossil extraction.

Demonstrate laboratory methods to treat, preserve and exhibit fossils.

Classify and identify fossils.

Define fossil fuels and explain how they were formed.

RATING METHODS FOR
GEOLOGIC EVENTS

Know how scientists date and reconstruct the earth's history.

Describe current methods of geologic dating such as Carbon 14, uranium, magnetic reversals and Potassium-Argon.

Describe the unique features of each strata of a geological formation that can be used to date the strata.

Explain the use of index fossils in dating.

Explain why the oldest rocks are at the bottom and the youngest rocks are on the top in an undisturbed geologic sequence.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

SPACE

Understand the relationship of earth
to the solar system and our galaxy.

Construct a model of the Milky Way galaxy showing
the location of our solar system.

Describe the characteristics of our galaxy.

Understand the role of space exploration
in obtaining knowledge about the earth
and ourselves.

Research and report on the major events which led
to space travel.

Report on one specific problem encountered in
space travel and tell how it was solved.

Describe the basic principles of rocketry.

Build a model of a rocket.

Explain the role of satellites in the study of
earth, including their role in assisting
communication in Alaska.

Illustrate the major events in manned space
exploration.

Create a senario depicting life in space.

SECONDARY SCIENCE
GEOLOGY
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

PEOPLE AND THEIR
ENVIRONMENT

Know limitations of the earth's resources.

Assess consequences of the world's population growth.

Develop a plan whereby people can minimize their depletion of the earth's resources.

Report on current environmental problems in Alaska and suggest possible solutions.

Create a senario describing life in the future if current resources continue to be depleted.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
SCIENCE METHODS	Know how physicists obtain knowledge.	Design a physics experiment which uses at least three scientific processes (observing, measuring, predicting, communicating, interpreting data, controlling variables, formulating hypotheses, classifying, using numbers, using space/time relationships, inferring, defining operationally, formulating models).
SCIENCE CAREERS	Know about careers in physics.	Research and report on the contributions of various scientists and organizations to laser research, development and applications (e.g., Bell Telephone Labs).
MATTER AND ENERGY	Understand the concept of energy.	Design an experiment to explain the formula, $E = mc^2$.
	Know how to conserve energy.	Prepare a plan showing how energy can be conserved including the benefits derived from energy conservation for the school, village, town, city or nation.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

MEASUREMENT

Understand the role of measurement
in scientific work.

Relate the history of the metric and customary
systems of measurement.

Design a laboratory experiment which demonstrates
accuracy and precision in computing and measuring.

Estimate answers for a problem involving
mathematical figures.

Convert numbers to scientific notation.

FORCE AND MOTION

Understand the basic laws of force
and motion.

Solve problems related to force and motion using
the correct laws.

Describe the motion of an object as seen from (1)
within a frame of reference; (2) outside a frame
of reference.

Understand vectors and their uses.

Resolve a vector into its appropriate components.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

FORCE AND MOTION (Cont.)

Understand the principle and implications of friction.

Design an experiment which demonstrates the principle of friction; describe the results.

Understand gravity.

Design an experiment which demonstrates the universal law of gravitational attraction.

Solve problems using the universal gravitational law.

Understand velocity and its related equation.

Determine velocity in laboratory exercises and problems using equations.

Understand the laws of momentum.

Explain the law of momentum using examples of collisions in both one and two dimensions.

Understand acceleration.

Derive the relationship among acceleration, time, and distance using an inclined plane, a ball and other devices.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
FORCE AND MOTION (Cont.)		
	Understand centripetal force.	Calculate acceleration given a problem and appropriate data.
	Understand fluids.	Measure centripetal force using a simple device.
		Demonstrate the basic laws of fluids using a hydraulic jack.
WORK, ENERGY AND POWER		
	Understand the relationship among work, energy and power.	Determine the amount of work done in a physical situation.
		Trace the flow of energy for a series of energy transfer problems.
		Solve for unknown variables, problems related to work, energy and power.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

ELECTRICITY AND MAGNETISM

Understand the basic principles of electricity and magnetism.

Apply the laws of electricity and magnetism to solve problems.

Demonstrate the relationship between electricity and magnetism using a coil of wire, galvanometer, bar magnets and iron filings.

Demonstrate the electroplating process according to Faraday's law using a galvanic cell, battery or other electrochemical device.

LIGHT

Understand how light behaves.

Demonstrate and explain wave characteristics of light and how it differs from the particle characteristics using a ripple tank or other devices.

Demonstrate how reflections from a plane mirror, concave mirror and convex mirror produce images.

Solve for unknowns such as focal length and image distance using lens problems.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
LIGHT (Cont.)		Demonstrate Snell's law using a light source, beaker of water, glass block, convex and concave lenses. Calculate the index of refraction of several materials. Demonstrate wave theory of light with respect to reflection, refraction, image formation, interference, and diffraction.
SOUND	Understand how sound behaves.	Demonstrate and explain the characteristics of sound waves (e.g., frequency, wave length, period, speed, intensity, rectilinear propagation). Demonstrate resonance. Demonstrate and explain the commonly recognized properties of sound perceived by humans (e.g., loudness, pitch, quality).

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT

LEARNING OUTCOME

SAMPLE LEARNING OBJECTIVE

The Learner will:

The Learner will:

HEAT

Understand heat energy.

Determine the amount of heat lost or gained by an object using a calorimeter.

Explain phase changes in liquids, solids and gases based on temperature data.

Apply the laws of thermodynamics to solve problems.

Relate the principles of the kinetic theory to the gas laws.

Solve for unknown variables such as volume, temperature and pressure using gas law problems.

Describe the characteristics of objects at near absolute temperatures.

NUCLEAR PHYSICS

Understand nuclear reactions.

List the reactions occurring in the nucleus, given examples of radioactive decay.

Explain the historical development of models of the atoms.

Calculate the half-life of selected radioactive substances.

Debate nuclear energy, supporting personal judgements with data.

SECONDARY SCIENCE
PHYSICS
GRADES 10 - 12

TOPIC/CONCEPT	LEARNING OUTCOME	SAMPLE LEARNING OBJECTIVE
	<u>The Learner will:</u>	<u>The Learner will:</u>
PARTICLE PHYSICS	Understand the composition of the atom.	Give a description of the roles particles play in the atom. Solve particle physics problems. Explain the Compton effect.
SOLID-STATE PHYSICS	Understand the basics of solid-state physics.	Prepare a report on solid-state physics in industry, including the production of such items as calculators, television sets, and radios.

ALASKA CURRICULUM GUIDE: Secondary Science

RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Robert Harty, Delta Greely S.D.	Some communities may not want the strong emphasis on personal, family, self-concept, decision making, emotional areas. Prefers an emphasis on such concrete areas as anatomy, senses, dental care, food, disease.	The external consultants, as well as a number of reviewers from Alaska felt the guide should reflect current thinking regarding science education; i.e., related to practical and everyday life. However, additional outcomes and objectives have been added in the concrete areas mentioned.
Robin Sims, ANDRO	<u>Grades 4-6</u> Submitted list of sample learning objectives, specific to Alaska, to include.	These have been incorporated into the material to the greatest extent possible.
Linda Franne, Marla Browne, ANDRO	<u>Grades K-3</u> Need to include resources education. Gear the curriculum to people, resources and their concerns. Included a list of objectives to add.	Done. Done. These have been incorporated into the material.
Jane Behlke to Virginia Johnson, APU	Audioconference is a good way to build a list of objectives.	Agreed.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Jane Behlke to Virginia Johnson, APU (Cont.)	Best kind of science education involves investigation of things around us.	Agreed, and the guide now reflects this to a limited extent.
	There should be a mandated evaluation instrument.	Agreed, although development of such an instrument is outside the scope of this project.
	It is more important to design a document for teachers.	The curriculum guides developed for this project were intended for use by curriculum directors and specialists.
Emma Walton to Ruth Keitz	The guide is too traditional and doesn't reflect current science thinking.	Agreed and appropriate revisions have been made.
	There needs to be more emphasis on space and the universe.	Additional outcomes have been added in these areas.
	Add more applied science.	Done.
	Add space science to earth science section.	Done.
	Allow the guide to change and evolve over time; do not let it become static.	This is definitely one intention of this project.
Robin Sims, ANROE	Submitted a document sharing an interdisciplinary approach to science, social studies, reading, language arts, P.E. and health and foreign language using environmental education objectives.	These have been incorporated into the material to the greatest extent possible.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Virginia Johnson, DOE in conjunction with ASTA and science educators	The guide needs to reach the nonscience-oriented student. Need to relate science to practical, everyday life. Include aims for the curriculum: critical thinking, processing, problem solving skills, evaluation, appendix.	Agreed and the material has been revised to reflect this approach. Agreed and appropriate revisions have been made. This has been done with the exception of the last two which are outside the scope of the project.
Louise Ashmun, from teleconference	The guide needs an evaluation component.	Development of an evaluation instrument was not planned as a function of this project.
Carl Reller, Dept. of Environmental Conservation	<u>Chemistry Only</u> Include environmental chemistry and hazardous waste chemistry. Specific comments written directly on the guide.	Done. These have been incorporated into the material to the greatest extent possible.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Sarah Nanuske-Hamilton, Iditarod S.D.	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
Tom Sheets, Iditarod S.D.	<u>Secondary</u> Need more emphasis on the hands-on and <u>how</u> to accomplish the learning objectives. Specific comments written directly on the guides.	More hands-on objectives have been added, however, development of teacher lesson plans are not a function of this project and are left to the discretion of individual teachers. These have been incorporated into the material to the greatest extent possible.
Phyllis Marchese, CCS, DOE	<u>General Concerns</u> 7th and 8th grade life science is more comprehensive than high school biology. Earth science is split unsuccessfully into earth science and geology; geology has left out earth science, leaving only atmosphere, climate and oceans which does meet the definition of earth science; astronomy and natural resources must be included. Topics and concepts are mixed together.	Additional outcomes and objectives have been added to the high school biology course. These changes have been made. The first column of the guide has been revised to include both topics and concepts.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Phyllis Marchese, CCS, DOE (Cont.)	Restructuring is needed throughout.	This has been done.
	The stem "The Learner will..." is often inconsistent with the statement that follows.	These have been carefully checked to ensure consistency.
	Need to examine the guides for correct order of skill and concept building.	Done.
	Outcomes and objectives need to be consistent.	All have been carefully checked and revisions made where necessary.
	The guides should include gifted and remedial courses.	It was decided by the Department in consultation with the Curriculum Cabinet that no remedial courses or programs be included in these guides as the learning outcomes sought are not different from regular courses or programs.
	Delete "mass" from resources and development.	Done.
	Combine earth science and geology; geology course should be more of an in-depth study with additional information on specific concepts.	It was decided to retain the two separate course designations but with additional objectives added.
	Submitted a concept/topic list for earth science.	These have been incorporated into the material to the greatest extent possible.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
Phyllis Marchese, CCS, DOE (Cont.)	<u>General Science 7-12</u>	
	Process skills and their definitions would be better under learning outcomes.	Agreed and this change has been made.
	Need to make the guide more relevant to the Alaska student and environment.	Done.
	<u>Physical Science</u>	
	Make it more relevant to Alaska and the student.	Done.
	<u>Geology</u>	
	Should be a part of earth sciences.	It was decided to retain the two separate course designations but with additional objectives added.
	<u>Physics</u>	
	Okay as is.	Minor revisions have been made.
	<u>Biology</u>	
E. Selig	Too much "cataloging of living organisms" -- the guide needs a thread such as "adaptation".	This change has been made.
	"Understand the nature of" is too vague; a comparison of anatomy and physiology would be better.	The outcome statements have been revised to reflect this approach to the greatest extent possible.
	Need more emphasis on biological processes and concepts.	Agreed and the material has been revised accordingly.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.

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RESPONDENTS	PROBLEMS, ISSUES, CONCERNS	DISPOSITION
E. Selig (Cont.)	<u>Chemistry</u>	
	Need to add concepts of solutions, solutes and solvents.	Done.
	The concepts given are really topics.	The first column is designed to include both topics and concepts.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
	<u>Life Science 7-12</u>	
	Some items are appropriate to high school, others to junior high.	The guide has been revised to reflect sequential development of knowledge and skills.
	It is not clear if students will take biology later; if life science is a high school course for nonbiology students, there needs to be some comparative anatomy and physiology included under adaptation along with a "variety of living organisms."	Additional objectives in these areas have been added.
	Specific comments written directly on the guide.	These have been incorporated into the material to the greatest extent possible.
Jane Angvik The Alaska Native Foundation	<u>Elementary and Secondary</u>	
	The material is generally appropriate and sensitive to Native Americans and Alaska Natives; however, the guides can be strengthened by using references drawn from the environment.	A section entitled "People and Their Environment" has been added to both elementary and secondary levels.

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Jane Angvik The Alaska Native Foundation (Cont.)	The behavior indicator to be "talkative" is not appropriate to most Alaska Natives.	This has been changed.
	Include more "observation" skills as this approach is still used by many Natives to study and learn.	Done.
	Include the following:	All have been added to the secondary science guide.
	o Discussion of utilization and conservation of natural resources.	
	o Discussion of methods for conserving energy.	
	o Discussion of current technological innovations adopted by Native people.	All have been added to the secondary science guide.
	o Discussion of weather and climate and how Native people predict the weather.	
	o Discussion of utilization of plants.	

ALASKA
MODEL
CURRICULUM
GUIDE
PROJECT

PERCENTAGE OF
EDUCATIONAL OUTCOMES

Subject: SCIENCE
Course:
Level: SECONDARY
Grade(s): 9-12
Date: 8-20-85

Histogram of Percentages

Objective	N	%	10	20	30	40	50	60	70	80	90	100
COGNITIVE	:	:										
1.10 Knowledge of specifics	: 12	6 :***										
1.20 Knowledge of ways and means of dealing with specifics	: 5	3 :**										
1.30 Knowledge of universals and abstractions	: 0	0 :										
2.00 Comprehension	: 97	49 :*****										
3.00 Application	: 47	24 :*****										
4.00 Analysis	: 19	10 :*****										
5.00 Synthesis	: 7	4 :**										
6.00 Evaluation	: 9	5 :***										
SUBTOTAL	:196	100 :										
AFFECTIVE	: 0	0 :										
PSYCHOMOTOR	: 0	0 :										
Not Classifiable	: 0	0 :										
TOTAL	:196	100 :										

